UHF RFID METAL TAG APPLYING TO LICENSE PLATE USING METAL SHIELDING AND WATERTIGHT METHODS

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Abstract: ***This paper describes a design for RFID (Radio Frequency Identification) tag using license plate attached the vehicle bumper in 900 MHz band. The implemented metal tag for a license plate is applied metal shielding method, watertight method of RFID tag, and metal corrosion protection method using silk screen technique. Moreover, its range of the fabricated tag antenna that the license plate and the vehicle bumper were fixed by volt and nut was observed 8.2 m. This measured readable range showed about 5 m above far distance more than the average readable range of commercial tag antenna. The RFID have ability of 0.5 seconds of recognition speed in the evaluation of performance. The tag for license plate will be able to provide to the custom administrator and goods manager in various telemetries services.***

Index Terms: Metal Tag, UHF RFID, Metal Shielding, Corrosion Protection, Watertight Method

I. INTRODUCTION

RFID (Radio Frequency Identification) technology has been around for many years. Before 2000, common uses for RFID in the USA included toll road passes, access ID cards and the tiny ID chips that are inserted in animals for identification purposes[1-7]. The recent introduction of RFID in the supply chain, retail store applications and tracking goods, as well as several mandates, has added to the awareness and value of this technology[1,3,5]. RFID is possible technology to recognize information of the characteristics ID from the product attached tag. The extension of RFID technology is able to use in the vehicle. However, to

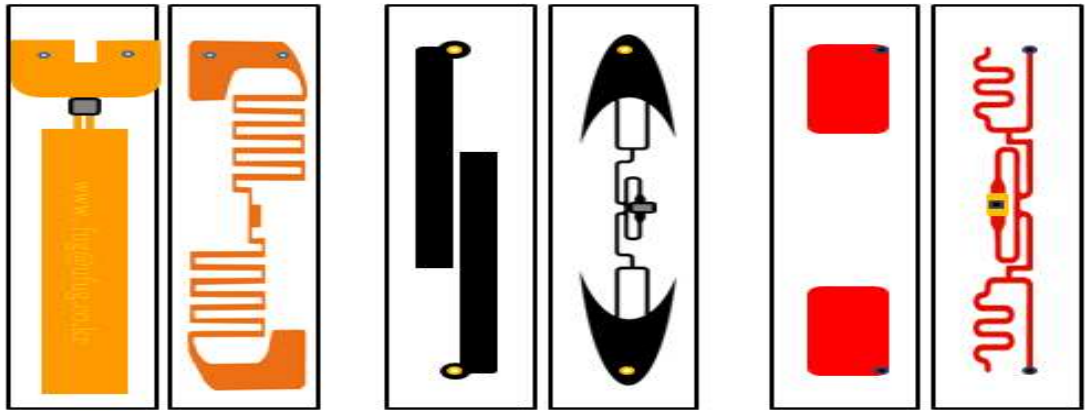
apply RFID tag in the license plate, we have to design and materialize the suitable RFID tag antenna in environment of the vehicle. In this case, Antenna attachment with complicating and extra expense is necessary. Additionally, tag antenna is weakly about around environment and attaching entity. Therefore, the operating characteristic of the tag changes and affect to recognition rate [8-13]. To determine the problem, the designed antenna deposit to minimize influence of a conductor on miler of vehicle. In this paper, to prevent the performance degradation in compliance with the electronic miraculous interference of the metal and damage and the variation by external shock, we developed metal transport RFID tag. There have been many researches about the development of specialized RFID tags that would guarantee a stable operation on the products containing conductors such as metals. Given the frequency band, low frequency bands such as 135 KHz and 13.56 MHz were mostly utilized in the earlier times[8,9]. The UHF (Ultra High Frequency) of territory using Back scattering is used in the field where is using RFID tag for physical distribution management in the American Department of Defense or the distribution company[9]. Standard approves the passive tag without necessary battery creating an electric current for operation. Previous RFID tags with the metal as like steel, container, gas case, drum of nuclear reactor is attached on metal products and there is problem to decrease recognition of the RFID remarkably. Received magnetic induction field from external antenna is been not well to form the induction electric current because of dispersed and reflection in compliance with the metal surface. Accordingly, there have been several trials on RFID tags that may prevent the electrical interference due to RFID tags attached on the metal products, thereby also preventing functional degradation of the tags. However, these trials are still in the early stages, requiring more thorough examination. In the paper, we developed 900 MHz RFID to apply a license plate using silk screen, metal shielding method.

II. DESIGN OF 900MHZ RFID METAL TAG FOR LICENSE PLATE

a. 900 MHz RFID Tag Design

900 MHz RFID tag enables to cognize maximum range and speed and it is designed by HFSS software which is excellent tool for design of RFID. Figure 1 shows the antenna feature for license plate with 900 MHz RFID. This paper evaluates the performance of cognizance for

speed and range in the license plate. It describes analysis of a reflection loss and the Smith chart regarding each RFID Tag pattern and will give proof which could be for license plate.



(a) Pattern #1 (b) Pattern #2 (c) Pattern #3 (d) Pattern #4 (e) Pattern #5 (f) Pattern #6

Figure 1. Pattern of 900MHz RFID Metal Tag used License Plate

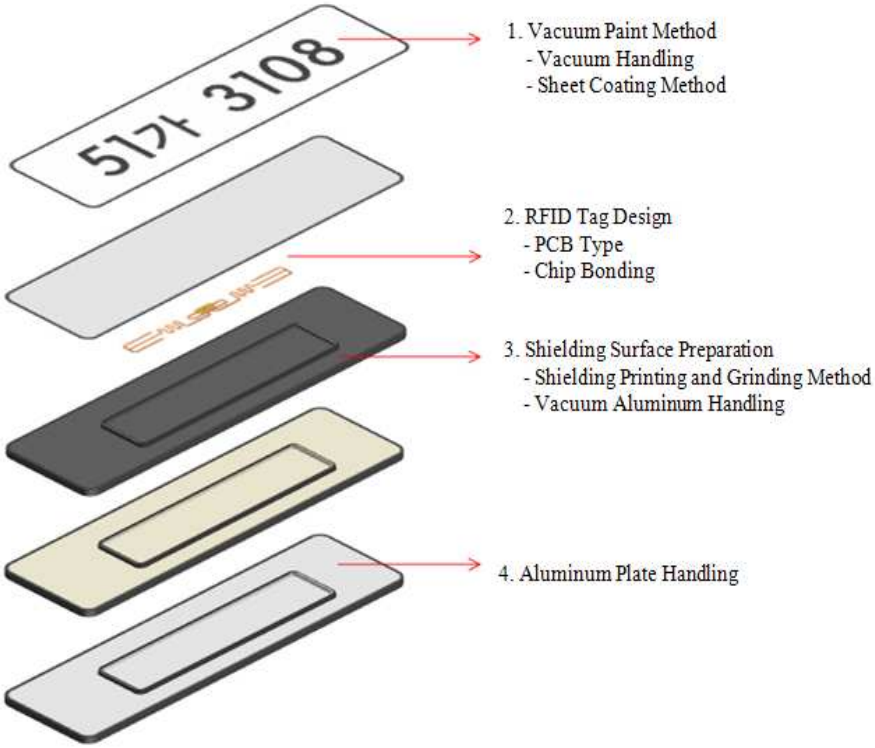


Figure 2. Configuration of 900MHz RFID Metal Tag for License Plate

A waterproofing technique for RFID with license plate is important. The processing of a vacuum method for License plate with RFID is semi permanently for maximum watertight.

Figure 2 shows the structure to make license plate with RFID for prevention about corrosion. The making license plate is consist of vacuum process, vacuum painting though sheet painting method, design of PCB type antenna by chip Boding, shielding surface process using vacuum aluminum of cutting method. To cognize the distance to 5~8m and the speed as 0.5sec, RFID Tag is designed in license plate which is ability of the metal screening and watertight function.

b. The Process of 900 MHz RFID License Plate

900 MHz RFID specialized tag for license plate is important to recognize reader accurately in anywhere. Hence the solution scheme on processing of development for specialized license plate tag is show below the Figure 3.

Step 1: Metal material shield processing ink and processed print

- ✓ Mixture control technique of specialized screening ink and ink with photoengraving technique.
- ✓ Silkscreen process: Improvement of the metallic screening RFID license plate using screening ink.

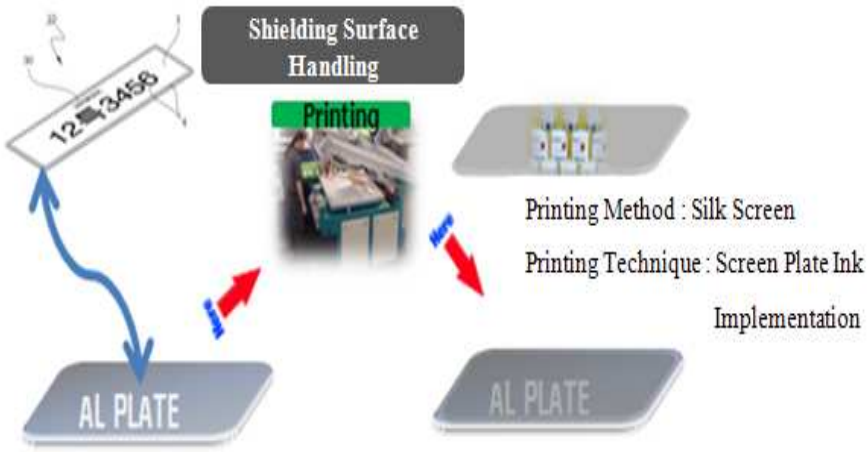


Figure 3. Metal Shielding Surface Handling and Printing Technique

Step 2: Implementation of antenna and patent & metallic antenna design.

- ✓ Antenna surface cover processing technique and ink technique
- ✓ Chip boning technique about metal

- ✓ Cover processing technique after chip bonding

The antenna printing technique which hits to an antenna pattern composition and a specialized metallic: antenna design and print of antenna for optimized cognizing distance.

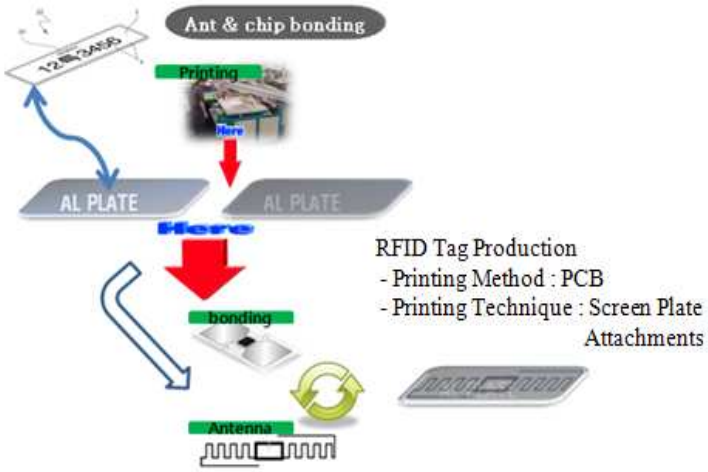


Figure 4. Design and Pattern of Antenna Configuration and Implementation.

Step 3: Antenna surface cover processing technique

- ✓ Processing surface print technique.
- ✓ To maintain waterproof of RFID antenna and complements problem about erosion of RFID license plate.

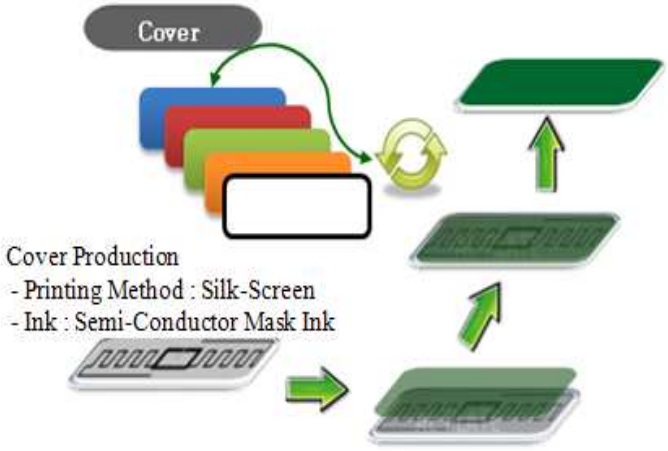


Figure 5. Antenna Cover Surface Processing Technique

Step 4: Pressing text and upload model number

- ✓ Control technique of tech pressed text.

Figure 6. Characters and Managed Model Number Processing

III. IMPLEMENT OF 900MHZ SPECIALIZED RFID NUMBER PLATE

a. Implementation of 900 MHz RFID Tag

In this paper like seeing from figure 1, the six types of 900 MHz RFID tag is designed by HFSS RFID tool software. The Figure 7 show technical structure of implemented 900 MHz RFID tag for license plate. Its width is 2.5cm, range is 2.5cm and thickness is 0.2cm.

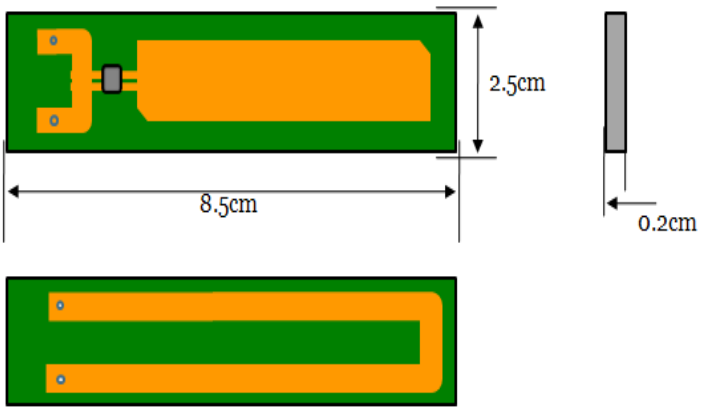
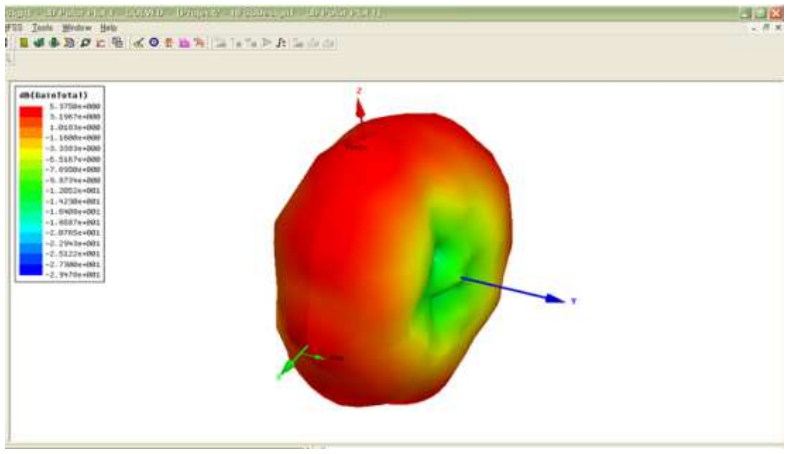
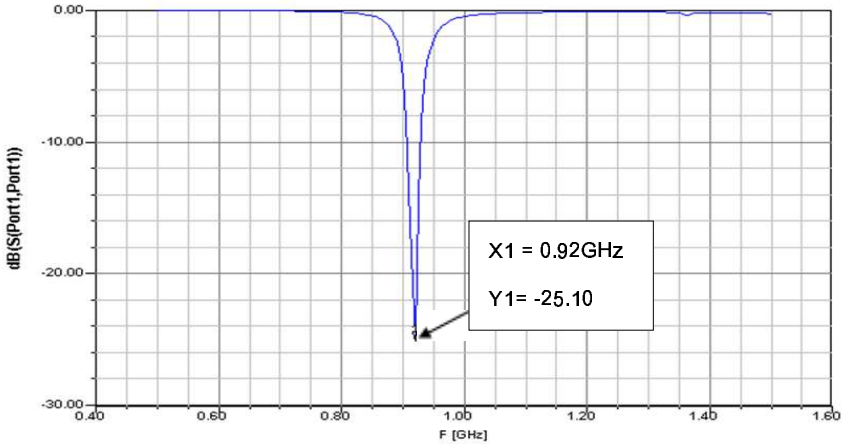


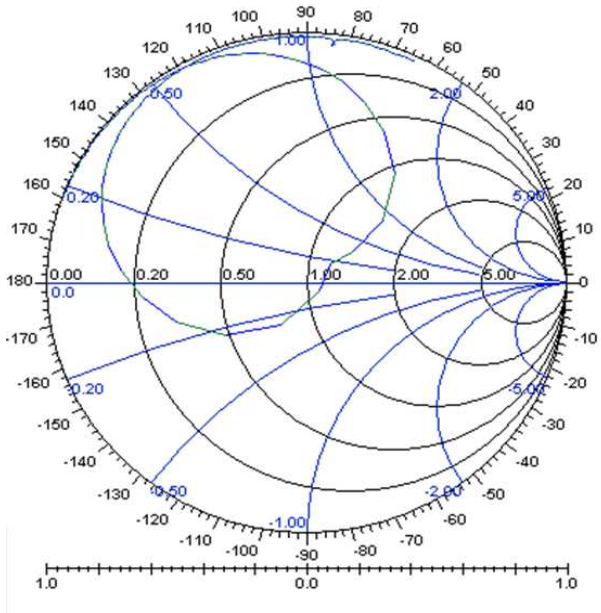
Figure 7. 900 MHz RFID Tag Configurations for License Plates



(a) 3D Polar Plot



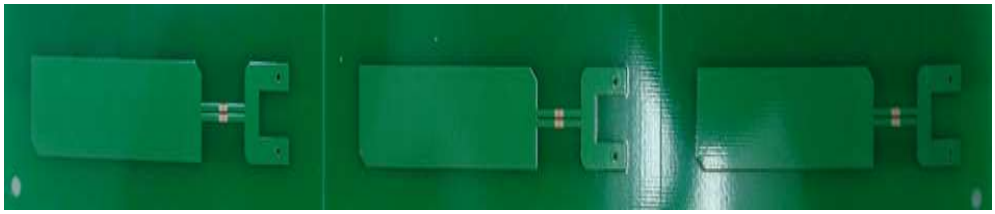
(b) Return loss



(c) Smith chart

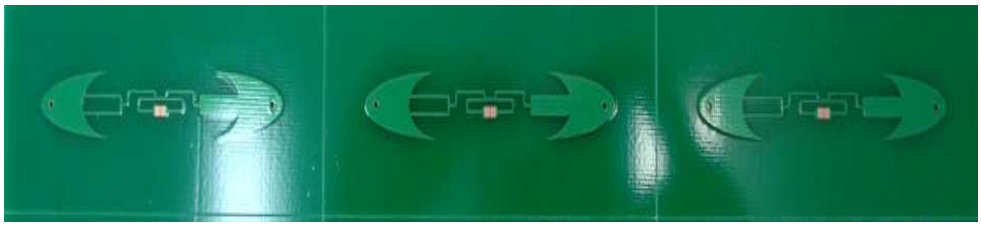
Figure 8. 3D Polar Plot, Return loss and Smith chart

We estimate the RFID tag of 6 kind forms using HFSS Tool in figure 1. After analysis with 3D Polar Plot and Smith Chart, The Pattern of #1, #2 and #3 are trait of the RFID about frequency 900 MHz band. Figure 8 shows Smith chart and 3D polar about pattern 1 in the figure 7. RFID has approximately 20db in 910 MHz frequency in smith chart and return loss and the impedance is 50Ω with matching. The 900 MHz RFID tag of 3 kind patterns which is excellent show among 3 PCB types to design HFSS tool in the figure 9.



(a) Pattern #1

(b) Pattern #2



(c) Pattern #3

Figure 9. Implemented RFID tag for license Plates

b. Implement of RFID tag in the 900 MHz band for license pate

To produces license plate where attaches 900 MHz RFID Tag, the technique is necessary the metal erosion shield techniques for license plate, metal screening technique and the silk screen with watertight of RFID Tag technical etc. To product RFID license plate is based on these techniques.

Step 1: RFID Tag Electronic Directional Maintenances

In order to propagate the electric wave, RFID Tag did not besiege with the aluminum and the minimum RFID Tag of one phase has to open for communication with RFID Reader. It does not cover all phase of RFID with metal to consider the radiation quality of RFID tag.

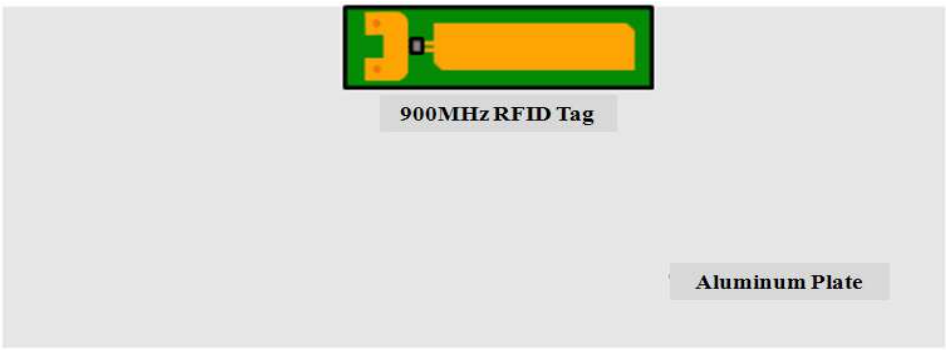


Figure 10. Position of RFID tag in Aluminum Plate

Step 2: Screening Shield Insertion:

The screening shield is inserted in license plate to reinforce metal vulnerability which is on aluminum plate, back and rear of bumper.

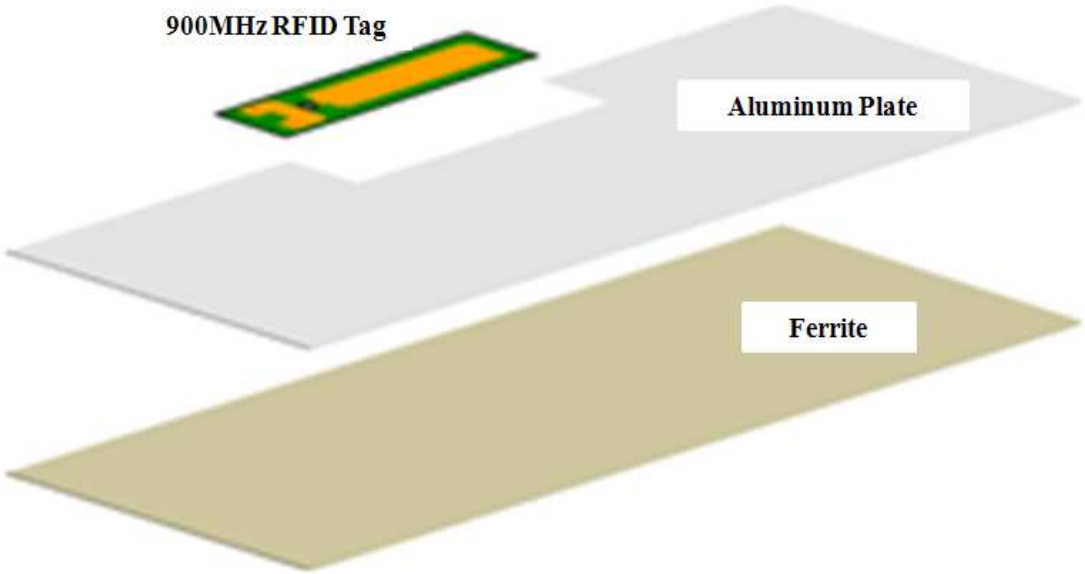


Figure 11. Screening Shield Insertion

Step 3: Drainage Control

The back side of the license plate processed ferrite and front side of the license of plate protected water-proof protect the RFID tag.

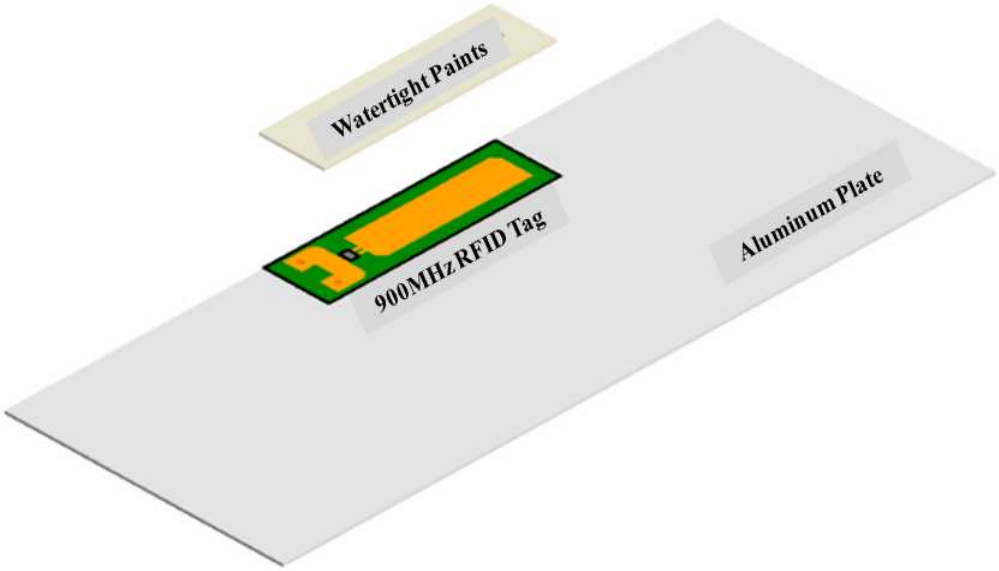


Figure 12. Watertight Paints on RFID Tag

Step 4: Erosion Shield

Before using the erosion shield coating compound, the aluminum plate combine RFID Tag which is processed water-proof paint.

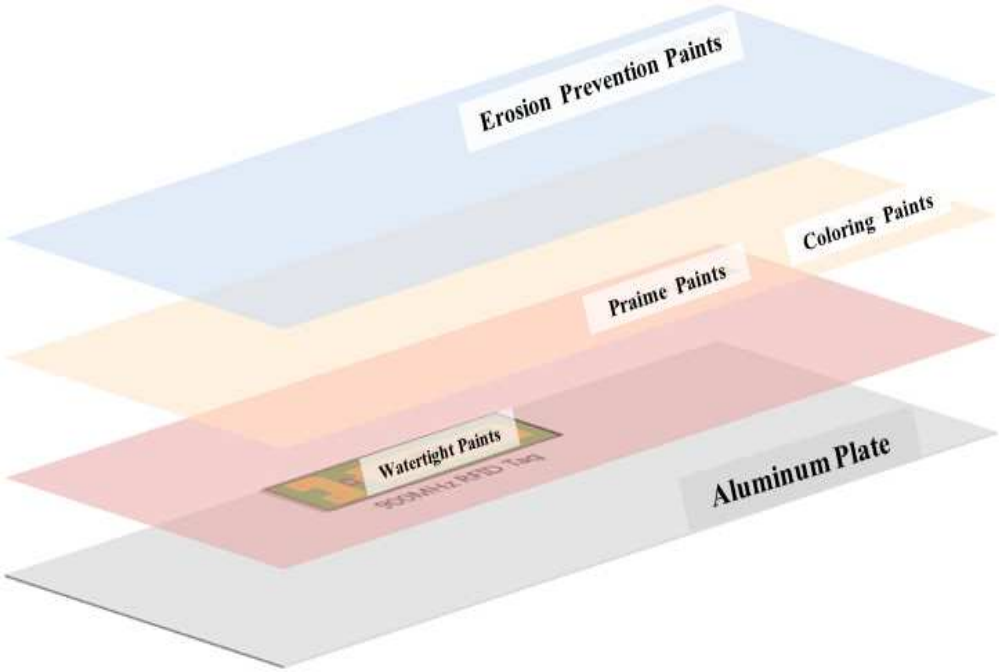


Figure 13. Erosion prevention paints

Step 5: Prototype Production:

After coloring the white coating above primer paints compound, it completed the base plate of the license plate and after put a black color to the number mold, prototype is implemented prototype attached black in the base plate after coloring the number mold.

Figure 14. 900 MHz RFID Tag License Plates

IV. EXPERIMENTAL RESULTS

The Figure 15 presents experiment equipment for efficiency testing about implemented 900 MHz RFID tag attached license plate. Like seeing from figure 15, we performed an experiment on testing bad which consist of 900 MHz antenna and reader modulation with RFID software about each patents.

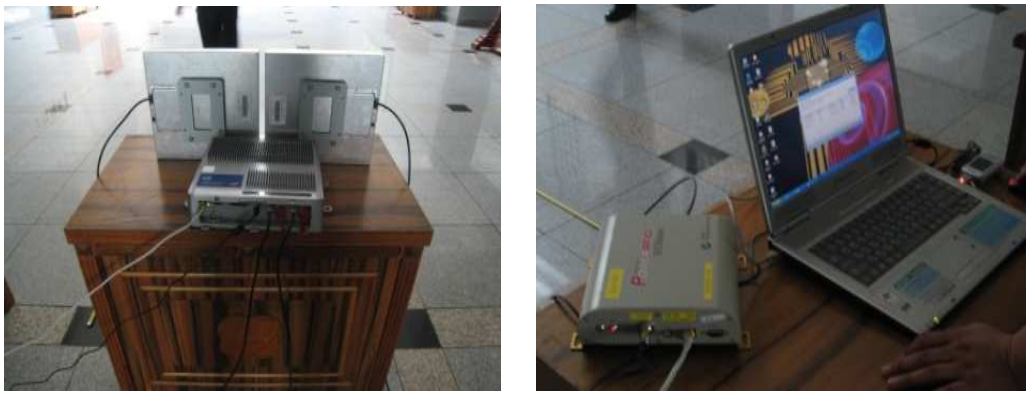
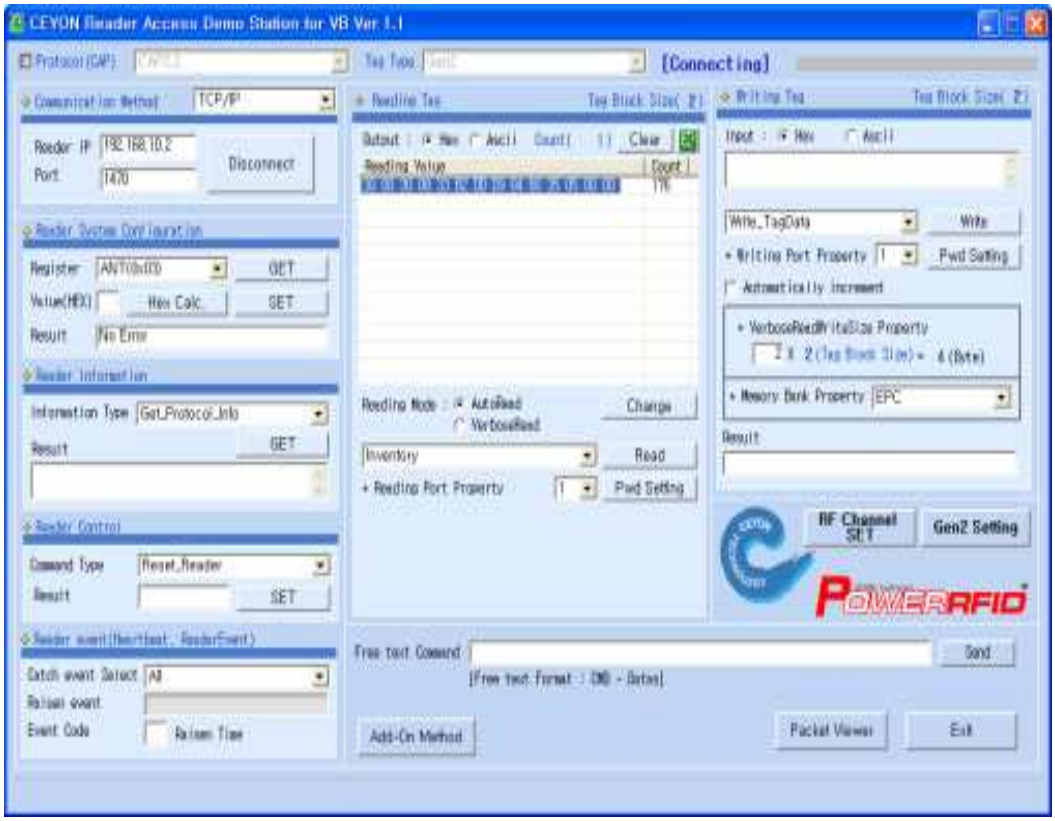
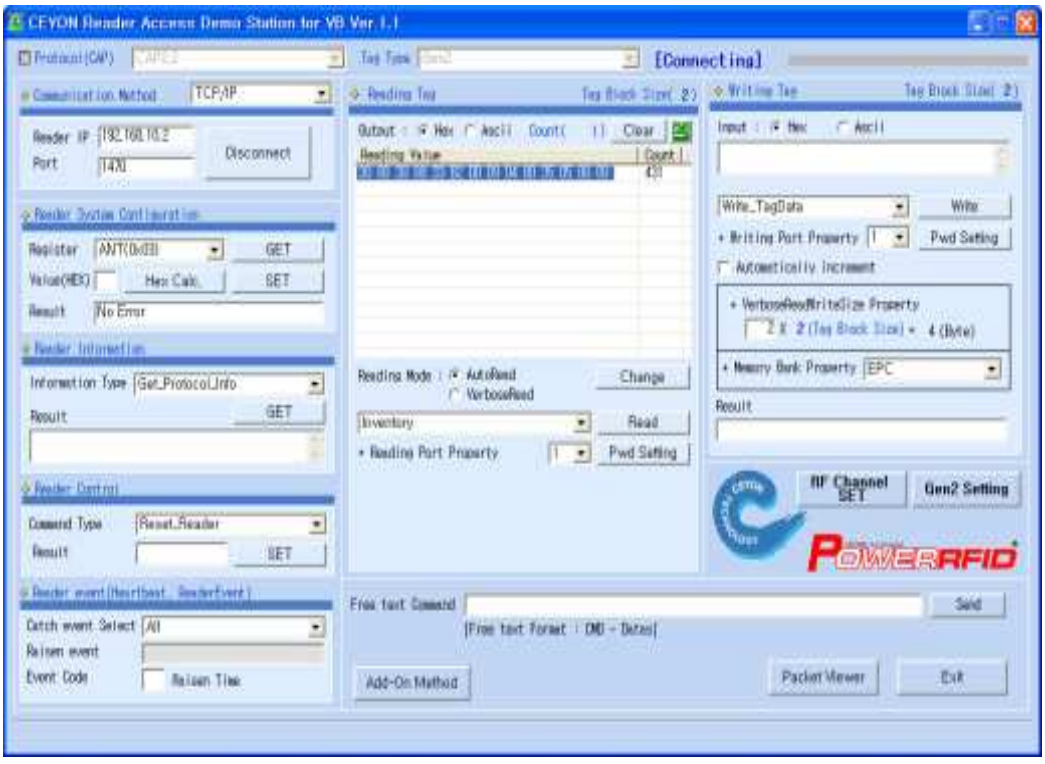


Figure 15. 900 MHz RFID Tag License Plates Test Device

We execute an efficiency test about the RFID tag license plate. The actual result of experiment is visible about the license plate with 900 MHz RFID tag in figure 16. As see the figure, each pattern has different character on speed and distance of perception.



(a) Pattern #1



(b) Pattern #2

Figure 16. License Plates Performance Tests

V. THE CONCLUSIONS OF ESTIMATION OF LICENSE PLATE WITH RFID TAG

The table 1 exhibited the result of UID (User Identification) recognition speed in license plate. The distance on experiment is 4m to RFID reader from license plate. The speed of awareness on developed 3 RFID pattern is excellent as such 0.5 sec as seeing table 1. The table 2 illustrates awareness distance about RFID with license plate and pattern 2 cognize well.

Table 1 RFID Tag is Built-in of the License Plate Stirs Recognized UID Speed

	Pattern #1	Pattern #2	Pattern #3
Cognition speed	0.5sec	0.5sec	0.5sec

Table 2 RFID Tag is Built-in License Plates of the Street

	Pattern #1	Pattern #2	Pattern #3
Cognition distance	6.3m	8.4m	5.7m

VI. CONCLUSIONS

This paper present to develop 900 MHz RFID license plate applied watertight technique of RFID tag and erosion shield technique by silkscreen. Implemented RFID tag in the 900 MHz band is designed by HFSS commonly and makes an experiment with entity. The developed RFID metal tag, we analyze its Return Loss using HFSS and its characteristics using Smith Chart methodology. RFID metal tag has approximately 20db in 910 MHz frequency and the impedance is 50Ω with matching.

We evaluate developed RFID license plate at the testing equipment and the RFID license tag is excellent performance to be 0.5 seconds as cognizing speed and 8.2 meters as cognizing distance. The RFID tag with license plate is possible to apply vehicle and will be important technology in the telemetric.

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